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ABSTRACT

This paper begins with a discussion of using multimedia technologies for education and teleconsultation using PC-based video-conferencing equipment. An overview is provided of the G7 (i.e., an informal forum of the seven major industrialized democracies) Global Healthcare Applications Project (GHAP), which aims at improving the quality and cost efficiency of health care delivery through telematics (remote access) tools. The paper then describes 2 of the 10 GHAP sub-projects, the Medical Image Reference Center (MEDIREC) and the International Online Academy (IOA). The objectives of MEDIREC are to support clinical activities, contribute to medical education and training, and facilitate medical research. Proposed reference centers would include clinical and pathological images (still and moving) and typical, rare, and difficult to diagnose cases. IOA provides the means for high quality, structured, and certified education and continuing education. (Contains 13 references.) (MES)

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Telematics Applications for High Quality Educational and Clinical Support to Practicing Professionals and Medical Students

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Abstract. The era we are living in is often referred to as "the age of communication". The combination of new and rapidly developing interactive multimedia computers and applications with electronic networks will require a restructuring of our traditional approach to strategic planning and organizational structure. World-wide telecommunication networks (using satellites, cable) are now facilitating the global pooling of healthcare information and medical knowledge independent of location. The G7 Global Healthcare Applications Project aims at improving quality and cost efficiency of healthcare delivery through telematics (remote access) tools. From these ten sub-projects two sub-projects are presented. The development of multimedia information and communication systems demands cooperative working teams of authors, who are able to master several areas of medical knowledge as well as the presentation of these in different multimedia forms. The assemblage of telematics and services offers a base for multimedia applications, for example teleteaching, telelearning, telepublishing, teleconsulting, teleconferencing, telemedicine etc. The expansion of the internet will also lead to the formation of interdisciplinary "Global Education Networks". The theory and practice of education are undergoing dramatic changes. Lifelong learning and adaptation of medical practice to new knowledge and new techniques will be even more important in the future.

1. Using Multimedia Technologies for Education

The internet technology is rapidly emerging as the most powerful medium of mass communication. Its WWW (World Wide Web) service has become a very important media for providing medical knowledge. Printed publications are more and more supplemented by electronical methods of publishing. Unfortunately the kinds of knowledge presentation in electronical media are often very similar to the traditional "patterns" that are used in printed books and scientific journals and are often only supplemented by hyperlinks and multimedia elements. The development of multimedia information and communication systems therefore demands

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cooperative working teams of authors, who are able to master several areas of medical knowledge as well as the presentation of these in different multimedia forms (text, graphics, images, audio, video). This way has opened up new possibilities and qualities for the training of medical students in universities and for further education of hospital physicians as well as for practicing professionals. The user's interaction with the information is made possible by visualization and simulation. Of significant importance are the possibilities of simulating diagnostic and therapeutic methods close to reality so that patients later can be treated more precisely by a perfectly prepared team. The learners can vary the parameters of experimental series of tests independently. In addition to internet services, the medical information is offered on CD/DVD-ROM and can be used in multimedia PCs. Such offline-media does not cause a pressure of time by the user and allows repetitions whenever necessary.

Often electronic publishing groups offer medical information systems online as Web based multimedia communication systems (for instance the Health Online Service multimedica [www.multimedica.de], Physicians Online [www.po.com], Virtual Hospital at the University of Iowa [www.vh.org]). Such systems contain knowledge from renowned experts. Special support for diagnostic and therapeutic strategies are available. These Web applications are useful for distance education and training of practicing physicians, specialists of all fields in practice and clinical environments, students as well as providing health news for patients and consumers.

2. Teleconsultation Using PC Based Video-Conferencing Equipment

Telematics services are becoming essential parts of health care strategies. The increasing demand for rapid transmission of medical visual information for purposes of telepathology and education poses difficult challenges in image compression techniques. Under consideration of international standards (H.320, H.323) for PC video-conferencing equipment, online teleconsultations with remote medical experts for cooperative discussion and interactive handling of medical data and pictures/images/frames are made possible. Pictures that can be used can include still images such as frozen sections or x-ray images as well as moving frames such as ultrasound. Figure 1 shows a cooperative discussion using Microsoft Netmeeting's Whiteboard between the Institute of Neuropathology of the Hannover Medical School (Germany) and the National Cancer Research Institute in Tokyo. A discussion using a remote ultrasound image is shown in figure 2.

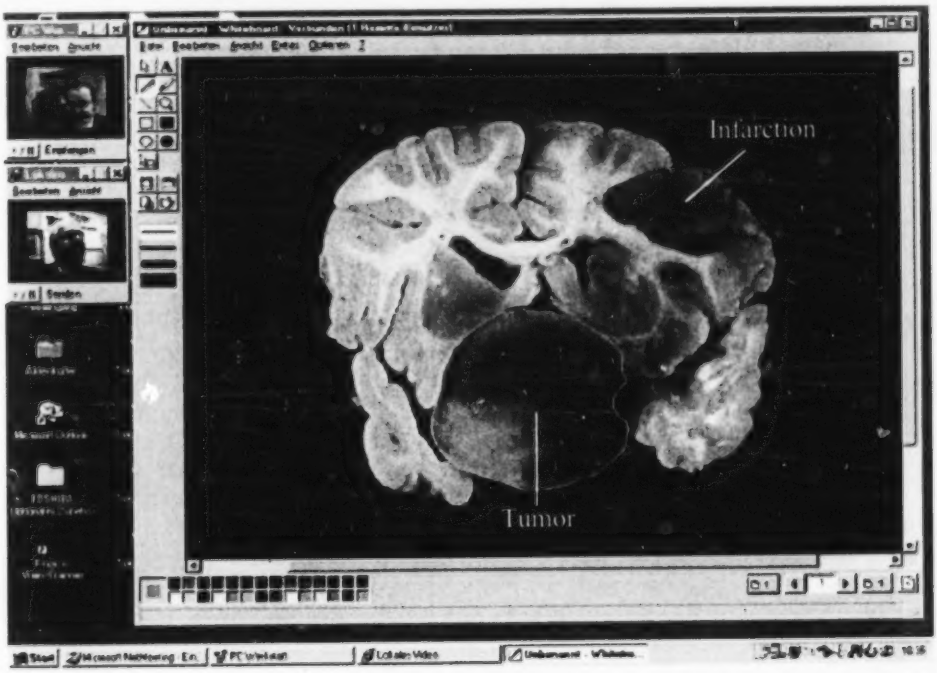

Figure 1: Teleconsultation using Whiteboard

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Figure 2: PC based video conference with remote ultrasound (life)

The main application of telematics in telepathology is the use of telemicroscopy. This will become more important since pathological expertise is not always available locally, and - in a worldwide sense - is extremely unevenly distributed. A first sucessful study at the Hannover Medical School was aimed to investigate the possibilities of teleneuropathology in a routine clinical setting [Matthies et al. 1998].

3. The G7 Global Healthcare Applications Project (GHAP)

The G7 is an informal forum of the seven major industrialized democracies. Ministers met in Brussels in 1995 and identified 11 pilot project areas for international co-operation, one is the GHAP. The G7 GHAP aims at improving quality and cost efficiency of healthcare delivery through telematics tools. It has ten sub-projects [www.gip.int]. Because this paper is only about education support possibilities we will only present the last two sub-projects

- Medical Image Reference Center (MEDIREC)
- IOA – International Online Academy (Special interactive TV and multimedia programs for professionals and public in dentistry and oral medicine).

4. The G7 GHAP Sub-Project MEDIREC

The objectives of this sub-project are to support clinical activities, contribute to medical education and training, and facilitate medical research. The proposed reference centers would include clinical and pathological images (still and moving) and typical, rare and difficult to diagnose cases. The G7 sub-project MEDIREC is co-ordinated by Japan [www.medirec.ncc.go.jp]. English language Medical Image Reference Centers are developed at the

- National Cancer Center Research Institute in Tokyo
  MEDIREC / Images of Cancer
- National Cardiovascular Center in Osaka

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MEDIREC / Images of Cardiovascular Diseases

- University of Regensburg
  MEDIREC / Images of Dermatology
- Hannover Medical School
  MEDIREC / Images of Neurological and Neuromuscular Diseases

Accessing such image databases via internet is possible. Data collection mechanisms, online publishing, and organization (including regional co-ordination centers), for example, have been proposed. A technical group will ensure interoperability with other image databases and will develop an information security management for file and image transfer.

In co-operation with the research centers specified above, a multilingual "MEDIREC / Images of Neurological and Neuromuscular Diseases" is being developed at the Hannover Medical School [Matthies et al. 1999a]. Efficient Web based database access to the MEDIREC at the Hannover Medical School is made possible via an Oracle Application Server that uses Java-based programs to answer requests, i.e. all authorized internet users may access the data using a standard web browser (e.g. Netscape, Microsoft Internet Explorer). An editorial board is responsible for the quality assurance of contents. The case examples for the MEDIREC in Hannover were prepared by the Institute of Neuropathology as well as the Medical Computing Center. The search masks and appropriate search results (fig. 3) can be displayed in several languages (WHO recommendation).

Figure 3: Query mask and query results in different languages

5. The G7 GHAP Sub-Project IOA

The expansion of the Internet will also lead to the formation of interdisciplinary "Global Education Networks". Such an exemplary network (fig. 5) will be realized in the G7 GHAP sub-project "MEDlive/IOA". The aim of the interactive "MEDlive" is to promote the international knowledge and information exchange in dentistry and oral medicine with telecommunication services, e.g. digital broadcast and internet services. The "International Online Academy of Dentistry and Oral Medicine" (IOA) is part of "MEDlive" and provides means for high quality, structured and certified education and continuing education.

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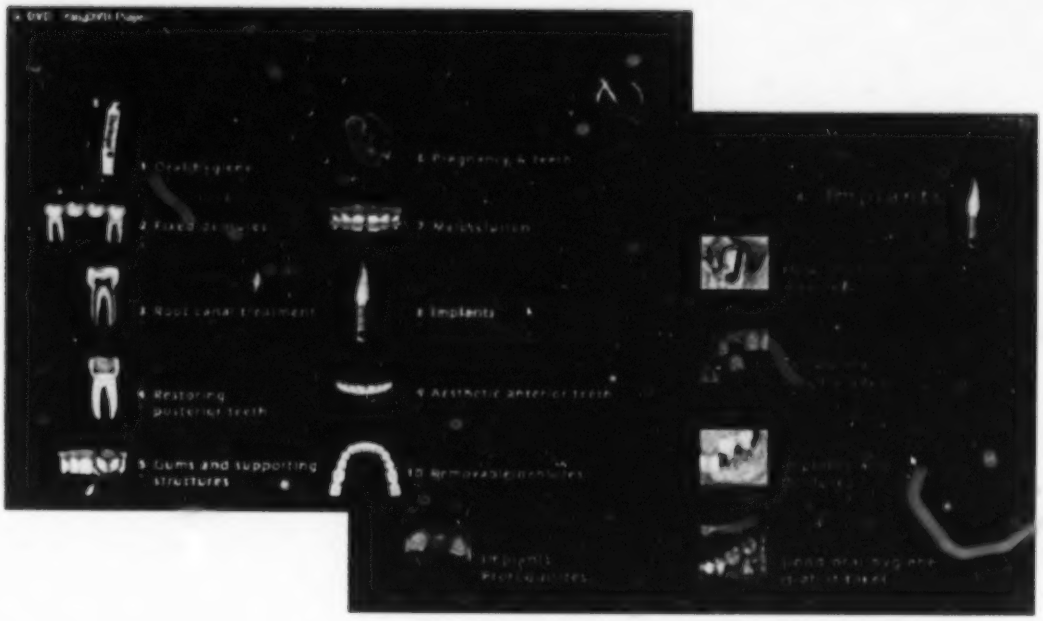

Figure 4: Video sequences for patient information

One day each week, video on-demand (fig. 4) is available as a test program via satellite television receivers (ASTRA) or television-based Web browsers. Project coordinator is the international Quintessence Publishing Group [quinline.globaldent.com] in Berlin. The aim of this engagement is to strengthen innovation, to assure the quality of content and to support the qualification and competence of the professionals on the road to the information society.

Figure 5: Link between MEDIREC and the G7 GHAP sub-project IOA

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6. Results

Telematics is a combination of telecommunications and informatics resulting in the transfer of information across distances. High rates of data transmission are necessary for the efficient use of multimedia technologies. Modern telematics infrastructures allow for instance

- flexible possibilities for distance learning
- world wide access to certified knowledge bases and digital image archives
- as well as simulations of and training for surgical procedures
- flexible training for the support of diagnosis and therapy by using visualization and simulation
- decision support for diagnostics and therapy
- creation of digital video libraries of clinical treatments.

The new information and communication systems open up new forms of learning and make it possible to combine classroom instruction/lecture and multimedia applications. New educational technologies and course contents will be required. First experiences have shown that in addition to medical lectures, specific offers for further education are required in dealing with electronical information sources. Learners' motivation will be improved by the access to multimedially supported teaching materials and contents. Problem-oriented learning will thus be possible and the quality of education will increase in general.

Multimedia technologies simplify the access to information from databases and electronical libraries. Renowned experts can give online support for healthcare professionals and patients. Knowledge and research results can nowadays be published and offered much quicker by the available telematics infrastructures. In contrast to printed books or video tapes, multimedia applications can permanently and easily be activated.

The theory and practice of education are undergoing dramatic changes. An innovative education resource for professionals and patients is the interactive use of multimedia applications in telecommunication networks. Video on-demand via satellite television receivers or television-based Web browsers will play an important role as effective user interfaces for access to broad range of knowledge and information resources. Learning is independent of time and location. The expansion of the internet will also lead to the formation of interdisciplinary "Global Education Networks" that focus on learning, not teaching. The challenge is not only for academic staff to change their work habits, but also for students to accept a changing concept of university education. Lifelong learning and adaptation of medical practice to new knowledge and new techniques will be even more important in the future.

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